REMARKS

This Amendment, in connection with the following remarks, is submitted as fully responsive to the Office Action. Claims 72-142 are pending. Applicant has amended claims 72, 76, 82, 99, 107-108, 112-113, 116, 118, 131 and 135. Claims 72, 82, 99, 108 and 131 are the independent claims. Favorable reconsideration is requested.

I. Objections to Claims

In the Office Action, claims 82, 99, 108 and 118 stand objected to because of various informalities. In view of the correcting amendments, these objections should be removed.

II. 35 U.S.C. § 101 and § 116 Rejections

Claims 72-116 stand rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Applicant has amended independent claims 72, 82, 99 and 108 so as to be tied to a data processor, which performs the claimed computerized methods, and additionally, to output the end result of the computerized methods to a user. For example, claim 72 has been amended to recite that a data processor receives, processes and combines the relevant data, and then outputs a best fit projection of the original data in an N-1 space to a user. Thus, in similar fashion as claims 117-142, claims 72-116 are now directed to patentable subject matter and this rejection should be removed.

Claims 76, 107, 112-113, and 116 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter

which applicant regards as the invention. In view of the correcting amendments to these claims, these rejections should be removed as well.

In this regard, Applicant notes that in claims 76 and 131, the term "GenD" algorithm has been amended to recite "Genetic Doping Algorithm", which is the full name of this algorithm. The Genetic Doping Algorithm is well known to those having ordinary skill in the art, and is, for example, described in detail in the article by Massimo Buscema, of the Semeion Research Center, Rome, Italy, entitled ***Genetic Doping Algorithm (GenD): Theory and Applications***, and appearing in Expert Systems, Vol. 21, pp. 63-79 (Blackwell Publishing, 2004).

The abstract of this article provides that "The evolutionary algorithm, GenD, was conceived by Buscema in 1998 at the Centro Ricerche di Scienze della Comunicazione – Semeion in Rome, where it is still successfully used and has been further developed. Unlike classic genetic algorithms, the GenD system maintains an inner instability during evolution, presenting a continuous evolution of the evolution and a natural increase in biodiversity during the progress of the algorithm. The theory which leads to defining the GenD system is outlined. Specific characteristics of GenD, such as the definition of a species-health aware evolutionary law, the use of genetic operators and the adoption of a structured organization of individuals (tribes), are described."

Additionally, the GenD algorithm is described in a 2000 technical paper described and incorporated by reference in ¶ [0037] of the Specification, and further, the algorithm is summarized at ¶¶ [0038] through [0054] of the Specification. As described in the cited articles and in the summary provided in the Specification, the GenD algorithm has notable innovative properties, and is not a standard "iterative algorithm" or even a standard "genetic algorithm" by any means.

III. 35 U.S.C. § 103(a) Rejections

In the Office Action, claims 72-93, 94-95, 96-97, 98, 100, 103-106 and 117-142 stand rejected under 35 U.SC. 103(a) as being unpatentable over Agrafiotis et al., U.S. Patent App. Publication 2002/0091655 ("Agrafiotis") in view of Stolte et al., U.S. Patent App. Publication 2004/0243593 ("Stolte"). Further, claims 99 and 101-102 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Agrafiotis in view of U.S. Patent No. 5,581,259 to Schipper ("Schipper"), and claims 107, and 114-115 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Agrafiotis in view of Stolte and further in view of U.S. Patent No. 5,680,331 to Blaney et al. ("Blaney"). Finally, claims 108-113, and 116 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Agrafiotis in view of Blaney.

The present invention relates to the field of artificial intelligence. It concerns projecting a set of data defined in a higher dimensional space into a lower dimensional space. *Specification* at [0003].[1] Such as, for example, from an N-dimensional space to an (N-1)-dimensional space while preserving the mutual relationships between data points. *Specification* at [0016] – [0022]. This is done, for example, by creating a first population of projections into the lesser dimensional space, and then the first population of projections is operated upon by a genetic or evolutionary algorithm to generate a second population of projections in the lesser dimensional space. *Id.*

The process continues so as to maximize a fitness score, which is an indication as to how closely the overall distances between the points in the lesser dimensional space mirror those in the higher dimensional space. Specification at [0034] – [0035]. The closer the original mutual

distances between data points are preserved in the projection of those data points into the lesser dimensional space, the better the "fitness score" and the more faithful to the original data the projection is. *Id.* Ultimately the genetic algorithm converges to a best solution, by creating a population of data points in the lesser dimensional space having the best fitness score. *Id.*

A noteworthy feature lies in the fact that successive generations of the population of data points in the lesser dimensional space are created by an evolutionary or genetic algorithm. *Specification* at [0035]. Additionally noteworthy is the fact that in exemplary embodiments of the present invention, in such an evolutionary algorithm, the number of marriages and of mutations are adaptive self-definable internal variables. Specification at ¶ [0053].

These features are neither taught nor suggested by Agrafiotis. Contrary to the assertions in the Office Action, Agrafiotis does not teach or suggest the use of an evolutionary algorithm at all, let alone an evolutionary algorithm as claimed.

Agrafiotis describes a mapping of "input patterns" from an n-dimensional space into an m-dimensional space accomplished via "subset refinements." Agrafiotis describes choosing a subset of the n-dimensional space input patterns and then using an "iterative nonlinear mapping process to map a training set of the n-dimensional input patterns into an m-dimensional space." Agrafiotis at Abstract. The method then uses a set of locally defined neural networks, themselves trained in the said iterative process, to map the remaining n-dimensional space input patterns. *Id.*

This is a fundamentally different process than the claimed invention. The claimed invention does not randomly divide the data points in the N-dimensional space into pieces, take

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[1] Citations to the present Specification herein are to its published version, U.S. Published Patent Application No. 2007/0100880.

one piece to train a neural network to "learn the underlying nonlinear transformation," [2] proceed to map that piece to an (N-1)-dimensional space, and then use the now trained neural network to map the remaining N-dimensional data points to the (N-1)-dimensional space, as if the "underlying nonlinear transformation" can be learned from a small piece of a data set and then assumed to uniformly apply to the entire data set, without using the entire data set as the training set.

In contrast to the "subset refinement technique" of Agrafiotis, in an evolutionary algorithm, all members of the population are critical. All data points are used in mutual interactions to arrive at the highest "fitness score." It is precisely the continued interaction ("marriages" and "mutations") between the entire population that drives the algorithm to converge at a set of data points with the best "fitness score." Using an evolutionary algorithm, you simply cannot extract some members of the population that are randomly chosen, as in Agrafiotis, and then attempt to find the "underlying nonlinear transformation" between this random training set and its projection into the (N-1)-dimensional space to train a neural network, and then use such a "proper transfer function" – now embodied in the trained neural network -- to process the remaining data points (which are much larger in number than those chosen as the "training set") to converge at a best fitness score.

In an evolutionary algorithm the data points themselves – the members of the "population" – are continually evolving towards a final "best fit" population, not just a neural network being modified by exposure to only a small random sample of the population. This is a fundamentally different approach than that of Agrafiotis.

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[2] This is the exact phrase used by Agrafiotis at ¶ [0042] for this process.

At page 6, the Office Action states that the algorithm of Agrafiotis at ¶¶ [0050] – [0053] teaches "calculating the N-1 coordinates of each record in the N-1 dimensional space using an evolutionary algorithm." Applicant respectfully traverses. This is simply untrue. The Agrafiotis algorithm at ¶¶ [0050] – [0053] is not an evolutionary algorithm. It is a "subset refinement algorithm" which seeks to extract the required transformation from n-dimensional points to m-dimensional points by processing only a subset of the total n-dimensional points, assuming that the learned rule universally applies across all data points.

In fact, the entire method of Agrafiotis is based on the "principle of probability sampling":

> [0042] A neural network architecture for reducing the dimensionality of very large data sets is presented here. The method is rooted on the principle of probability sampling, i.e. the notion that a small number of randomly chosen members of a given population will tend to have the same characteristics, and in the same proportion, with the population as a whole. The approach employs an iterative algorithm based on subset refinements to nonlinearly map a small random sample which reflects the overall structure of the data, and then "learns" the underlying nonlinear transform using a set of distributed neural networks, each specializing in a particular domain of the feature space. The partitioning of the data space can be carried out using a clustering methodology. This local approach eliminates a significant portion of the imperfection of the nonlinear maps produced by a single multi-layer perceptron, and does so without a significant computational overhead. The proposed architecture is general and can be used to extract constraint surfaces of any desired dimensionality.

Agrafiotis at ¶ [0042] (emphasis added).

This method of Agrafiotis is the antithesis of an evolutionary or genetic algorithm, which assumes that each and every member of the population contributes to the evolution of the species to a more developed – more fit -- state.

The Office Action itself highlights this fundamental distinction. In its rejection of dependent claim 76, which recites that the claimed evolutionary algorithm can be a GenD genetic algorithm, the Office Action cites to a description of "Sammon's nonlinear mapping

algorithm" in the background section of Agrafiotis. Agrafiotis at ¶ [0021]. This Sammon's algorithm is not an evolutionary algorithm at all! Moreover, it is certainly not the Genetic Doping Algorithm of claim 76 that is described in the article cited to and incorporated in the Specification. Applicant respectfully submits that the Office Action may have completely misunderstood what the GenD algorithm is.

Because Agrafiotis does not teach any type of evolutionary algorithm, it certainly does not teach the claimed evolutionary algorithm wherein the number of marriages and of mutations of individuals are adaptive self-definable internal variables.

Thus, for the above-mentioned reasons, independent claims 72, 82, 99, 108 and 131, as amended, are urged as patentable over Agrafiotis. The remaining dependent claims are also patentable over Agrafiotis for similar reasons.

While Agrafiotis generally describes a projection form an n-dimensional space to one of m-dimensions, the Office Action readily admits that Agrafiotis does not teach the claimed projection from an N to an N-1 dimensional space. To teach that feature the Office Action combines Agrafiotis with Stolte, and cites to Stolte at Fig. 15 and ¶ [0189], where "the first projection summarizes across "Location", reducing the 3-dimensional cube to a 2-dimensional cube." This is a classic projection of 3D data into two dimensions. In Fig. 15 of Stolte there is depicted a 3D cube. The cube has three axes, labeled "Time" "Products" and "Location." The results of a 1D and a 2D projection are shown. In the 2D projection the "Location" axis is deleted, and all locations are aggregated. Thus, in the original 3D cube of Fig. 15 of Stolte there could be data points having identical products and times, but be at diametrically opposite locations, such as one at the east, and the other at the south. These points could have a significant distance between them in the original 3D (N-dimensional space) and zero distance

between them in the 2D (N-1 dimensional space) projection. This failure to preserve such a distance is precisely what the claimed invention intends to avoid. It avoids it not by allowing such a linear projection, but by operating on the N-dimensional data points so as to best fit their mutual distances in the original N-dimensional space to their mutual distances in the (N-1)-dimensional space.

Stolte here teaches a simple linear projection, precisely contrary to the stated approach of the claimed invention, as provided in the present Specification:

> [0013] This kind of projection algorithm working only on the base of linear projections determines that some information will be lost during the projection. In order to understand this situation consider a normal projection from a three dimensional space onto a two dimensional space. In a linear projections two points having a certain distance along one of the three dimensions might appear very near if the two dimensional projection space is perpendicular to the third dimension along which the two points are spaced apart. In a very simplified manner this situation takes place using PCA algorithm. The result of the known technique is that in the less dimensional space where the information data has been projected the data relationships is distorted in a dramatic way and the distortion can go so far as to cancel or abnormally enhance relationships between data.
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> [0014] The algorithm according to the present invention has the aim of projecting N-dimensional information data onto a less dimensional, particularly onto a two or three dimensional space without distorting in an excessive manner the relationships between data.

Specification at ¶¶ [0013] – [0014] (emphasis added).

Thus, Stolte actually teaches away from the claimed invention, and cannot reasonably be combined with Agrafiotis to teach a projection from N dimensions to N-1 dimensions that accomplishes the method of the invention, namely, to use an evolutionary algorithm to converge the projected set of data points in the (N-1)-dimension to a best solution, by evolving a population of data points in the lesser dimensional space to have the best fitness score.

As noted above, the Office Action also cited to Schipper, directed to methods for determining the present location coordinates of a user moving in a two-dimensional or three-dimensional space with reference to an old map that may be inaccurate, as well as to Blaney, directed to a method for generating multiple mimics of an active site of a molecule, such as a protein, using computer modeling of the active site.

Moreover, none of Stolte, Schipper and Blaney are seen by Applicant as curing the defects of Agrafiotis as a reference against the amended independent claims. None of these references teach calculating the N-1 coordinates of each record in the (N-1)-dimensional space using an evolutionary algorithm as claimed, wherein in such evolutionary algorithm the number of marriages and mutations of individuals are adaptive self-definable internal variables. Thus, independent claims 72, 82, 99, 108 and 131, as amended, are urged as patentable over each of Agrafiotis, Stolte, Schipper and Blaney, whether taken individually or in any combination. The remaining dependent claims are also patentable over Agrafiotis, Stolte, Schipper and Blaney for similar reasons.

Applicant recognizes that the subject matter of the invention is somewhat complex, and that the claimed methods claimed may read as rather abstract. Applicant would welcome the opportunity to have a personal interview with the Examiner and interactively present some real world examples, so as to make sure Applicant's claimed invention and arguments in support of patentability are fully appreciated.

No additional fees are believed due herewith. However, if any additional fees are due,

the Commissioner is hereby authorized to charge any fee deemed necessary for the entry of this Amendment and Response to Office Action to Deposit Account No. 50-0540.

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Respectfully submitted,

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